

WHAT IS CLAIMED IS:

1. A semiconductor wafer processing system comprising:  
an atmospheric front end unit including a front end robot for transporting a semiconductor wafer;  
a multi-chamber module, said multi-chamber module including a plurality of  
5 vertically-stacked semiconductor wafer process chambers;  
a loadlock chamber provided for each semiconductor wafer process chamber, wherein said robot transfers the wafer into said loadlock chambers; and  
a wafer transfer apparatus provided for each loadlock chamber and dedicated to each  
10 respective wafer process chamber for transferring the wafer between said each loadlock chamber and said respective wafer process chamber.
2. A semiconductor wafer processing system according to claim 1 further comprising a common process chemical delivery system supplying chemicals to said plurality of said process chambers
3. A semiconductor wafer processing system according to claim 1 further comprising at least two multi-chamber modules, said multi-chamber modules oriented in a linear array.
4. A semiconductor wafer processing system according to claim 1 in which said wafer transport apparatus includes a dual-wafer single-axis transfer arm pivotally mounted within said loadlock chamber, said transfer arm having a retracted home position, an extended position where it extends into said process chamber, and a single pivot axis about which said transfer arm pivots between said retracted and extended positions.
5. A semiconductor wafer system according to claim 4, wherein said transfer arm further includes a lower wafer shelf and an upper wafer shelf.
6. A semiconductor wafer processing system according to claim 4, wherein each said loadlock chamber further includes a cooling plate disposed below said transfer arm when said transfer arm is in said retracted position.

7. A semiconductor processing system according to claim 6, wherein said cooling plate further includes a plurality of lift pins for lifting the wafer for loading and unloading the wafer onto said upper wafer shelf and said lower wafer shelf.
8. A semiconductor wafer processing system according to claim 1, wherein each said process chamber further comprises a wafer chuck assembly for receiving the wafer from said transfer arm and holding the wafer within said process chamber.
9. A semiconductor wafer processing system according to claim 8 wherein said wafer chuck assembly comprises:
  - a chuck clamping surface for securing a wafer to said wafer chuck; and
  - a plurality of lift pins for transporting the wafer between said transfer arm and said clamping surface.
10. A semiconductor wafer processing system according to claim 8 wherein said wafer chuck assembly comprises a chuck translation frame for translating the wafer between a load position and a processing position.
11. A semiconductor wafer processing system according to claim 10 further comprising a chuck assembly adjustor for adjusting pitch, roll, and height of said chuck assembly relative to said process chamber.
12. A semiconductor wafer processing system according to claim 10 comprising three chuck assembly adjustors for adjusting pitch, roll, and height of said chuck assembly relative to said process chamber.
13. A semiconductor wafer processing system according to claim 1 wherein said process chamber comprises:
  - a chemical vapor deposition linear injector fixedly mounted within said process chamber;
  - a wafer chuck assembly for receiving the wafer from said transfer arm and translating

the wafer past said linear injector.

14. A semiconductor wafer process apparatus comprising:

a dual-wafer single-axis transfer arm adapted to carry and transfer semiconductor wafers between a loadlock chamber and a semiconductor wafer process chamber, said transfer arm having a monolithic arm pivotally mounted within said loadlock chamber about a single pivot axis;

wherein said transfer arm is adapted to carry at least two wafers simultaneously between said loadlock chamber and said process chamber.

15. A semiconductor wafer process apparatus according to claim 14, said transfer arm further including:

a retracted home position and an extended position in which said transfer arm extends into said process chamber, wherein said single pivot axis allows said transfer arm to pivot between said retracted and extended positions; and

a cooling plate disposed below said transfer arm when said pivot arm is in said retracted position.

16. A semiconductor processing system according to claim 15 wherein said cooling plate further comprises a plurality of lift pins for transporting the wafers between said cooling plate and said transfer arm.

17. A semiconductor wafer process apparatus according to claim 14 wherein said transfer arm further comprises a lower wafer shelf for carrying a processed wafer and an upper wafer shelf for carrying an unprocessed wafer.

18. A semiconductor processing system according to Claim 14 wherein said transfer arm is adopted to simultaneously carry one unprocessed wafer and one processed wafer.

19. A method of semiconductor wafer processing comprising the steps of:

providing a loadlock chamber having a transfer arm including an upper wafer shelf

for carrying unprocessed wafers and a lower wafer shelf for carrying processed wafers, and a semiconductor wafer process chamber;

simultaneously transferring a processed wafer and an unprocessed wafer between said loadlock chamber and said process chamber.

20. A method of semiconductor wafer processing according to claim 19 further comprising the step:

evacuating said loadlock chamber prior to simultaneously transferring a processed wafer and an unprocessed wafer between said loadlock chamber and said process chamber.

21. A method of semiconductor wafer processing according to claim 19, wherein the providing step further includes providing a cooling plate within said loadlock chamber, said method further comprising:

transferring said process wafer from said lower wafer shelf to said cooling plate.

22. A method of semiconductor wafer processing according to claim 21 further comprising;

transporting said unprocessed wafer on said upper wafer shelf from said loadlock chamber to said process chamber;

5 transferring said unprocessed wafer from said upper wafer shelf to a wafer chuck mounted in said semiconductor wafer chamber,

translating said wafer chuck from a retracted position, past a chemical vapor deposition injector mounted in said semiconductor wafer process chamber, to an extended position, whereby an unprocessed wafer is processed into a processed wafer.

23. A method of semiconductor wafer processing according to claim 19 further comprising the steps prior to the simultaneously transferring step:

receiving a first unprocessed wafer on the transfer arm;

transferring said first unprocessed wafer to said process chamber;

5 concurrently processing said first unprocessed wafer into a first processed wafer and receiving a second unprocessed wafer on the transfer arm; and

retrieving said first processed wafer by said transfer arm while holding said second unprocessed wafer on said transfer arm.

24. A method of semiconductor wafer processing comprising the steps of:

providing an atmospheric front end unit including a front end robot for transporting a semiconductor wafer, a multi-chamber module including a plurality of vertically-stacked semiconductor wafer process chambers, a loadlock chamber for each semiconductor wafer process chamber, and a wafer transfer apparatus for each loadlock chamber, each said loadlock chamber and each said wafer transfer apparatus dedicated to a respective wafer process chamber;

transporting a wafer between said atmospheric front end unit and one of said loadlock chambers via said robot; and

transferring the wafer between said one loadlock chamber and a respective wafer process chamber via said wafer transfer apparatus.

25. A semiconductor wafer processing system comprising:

a removable wafer load cassette;

an atmospheric-pressure front end unit including a front end robot for transporting a semiconductor wafer;

a plurality of semiconductor wafer process chambers, each said semiconductor wafer process chamber including

a wafer chuck assembly for translating the wafer within said process chamber, said wafer chuck assembly having a chuck clamping surface for securing a wafer to said wafer chuck,

a plurality of lift pins for transporting the wafer between said transfer arm and said clamping surface, and

a chuck translation frame for translating the wafer between a load position and a processing position;

a multi-chamber module, said multi-chamber module including two or more said semiconductor wafer process chambers in a vertically-stacked orientation;

a loadlock chamber provided for each semiconductor wafer process chamber

including

- 20 a dual-wafer single-axis transfer arm adapted to carry and transfer semiconductor wafers between said loadlock chamber and said semiconductor wafer process chamber, said transfer arm having a monolithic arm pivotally mounted within said loadlock chamber about a single pivot axis, said transfer arm having a retracted home position and an extended position where it extends into said process chamber, wherein said single pivot axis allows said transfer arm to pivot between said retracted and extended positions, and
- 25 a cooling plate disposed below said transfer arm when said pivot arm is in said retracted position, said cooling plate including a plurality of lift pins for transporting the wafers between said cooling plate and said transfer arm.